

## LOOP-POWERED T1 RADIO

FIELD OF THE INVENTION

The present invention relates in general to telecommunication systems and subsystems therefor, and is particularly directed to a loop-powered digital 5 radio, that is coupled to and powered by a digital communication signal-transporting wireline (such as a powered T1 wireline). The radio of the invention not only interfaces digital communication signals with the line, but is configured to extract electrical power 10 from the line and convert the extracted power to voltages necessary for operating the radio. The radio transmits and receives digital communication signals with respect to a remote and relatively low wattage digital (e.g., 'blue tooth' radio).

15 BACKGROUND OF THE INVENTION

Although legacy (copper) wirelines serve as a principal information transport backbone for a variety of telecommunication networks, other signal transport technologies, particularly those capable of relatively 20 wideband service, including coaxial cable, fiber optic and wireless systems, have undergone rapid development and now serve a diversity of environments and users. A

particular advantage of wireless (e.g., radio) service is the fact that it is very flexible and not limited to serving only customers having access to existing or readily installable cable plants.

5       Moreover, there are many environments, such as, but not limited to portable data terminal equipments (DTEs), where a digital wireless subsystem may be the only practical means of communication. In order to provide digital communication service, the wireless 10 (radio) subsystem must not only be interfaced with an existing digital network's infrastructure, which typically includes legacy wireline links (that may contain one or more repeaters) coupled to an incumbent local exchange carrier (ILEC), such as a Bell operating 15 company (RBOC) site, but the digital radio site which provides access to the wireline must also provide a source of electrical power. In many environments, the required power supply is either not readily available, or its cost of installation is prohibitively expensive.

20       SUMMARY OF THE INVENTION

In accordance with the present invention, such lack of, or the unacceptably high cost of installing a power supply for a wireless communication equipment intended to wirelessly connect existing digital 25 communication network equipment with a remote site is

successfully remedied by loop-powered digital (T1) radio. As will be described, the loop-powered T1 radio of the invention is configured to be installable at a location (such as a rooftop or pole site), that does 5 not readily afford access to a dedicated power supply for the radio. The remote radio may comprise a blue tooth digital radio associated with portable digital terminal equipment, such as a notebook computer, or a remote digital radio that terminates a separate powered 10 wireline.

For this purpose, the loop-powered radio of the invention includes a line interface coupled to tip and ring portions of respective transmit and receive segments of a powered T1 wireline link. The line 15 interface contains conventional coupling transformer circuitry that extracts (+/-48 V) DC voltages of the powered tip and ring wireline pairs for application to a DC-DC voltage converter, and also interfaces digital signals transported by the powered T1 link to a T1 20 framer chip. The DC-DC converter scales down the +/-48 VDC voltages supplied by the span to standard voltages (e.g., +5 V and +12 V), used to power the digital signaling and transceiver electronics of the radio.

The transceiver section of the radio is preferably 25 of standard (e.g. 'blue tooth'-compatible) design and includes a transmitter unit coupled to receive the

digital baseband signals from the T1 framer chip and perform modulation and up-conversion to an FCC-conformal band RF signal (e.g., 2.4 GHz spread spectrum signal). The radio's receiver unit performs down-  
5 conversion and demodulation of the (2.4 GHz) RF signal to baseband for application to the T1 framer chip.

By extracting electrical power from the line and converting the extracted power to voltages for operating its transceiver and signal processing  
10 components, the invention effectively eliminates the need of having to locate the radio where a separate dedicated power supply is either available or can be installed. Being totally self-contained, the loop-powered radio of the invention may be installed  
15 practically anywhere access to a powered wireline is available.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 diagrammatically illustrates a hybrid wireline/radio based digital telecommunications system  
20 for conducting digital (T1) communications between a pair of spaced apart 'west' and 'east' sites; and

Figure 2 diagrammatically illustrates the architecture of a wireline-powered T1 radio that may be installed at one or more wireline access points of the  
25 system of Figure 1.

### DETAILED DESCRIPTION

Before describing in detail the new and improved loop-powered T1 radio of the present invention, it should be observed that the invention resides primarily

5 in modular arrangements of conventional wireless (radio) transceiver components, digital communication circuits, power supply and interface components. In terms of a practical implementation that facilitates their manufacture and installation at a communication

10 site having access to an existing digital signal transporting wireline cable plant, these modular arrangements may be readily configured using field programmable gate array (FPGA) and application specific integrated circuit (ASIC) chip sets, and commercially

15 available devices and components. As a consequence, the configurations of these arrangements and the manner in which they may be interfaced with an existing digital signal (T1) wireline link have been illustrated in readily understandable block diagram format, which

20 shows only those specific details that are pertinent to the present invention, so as not to obscure the disclosure with details that are readily apparent to one skilled in the art having the benefit of present description.

25 A non-limiting, but preferred embodiment of a digital telecommunication system with which the loop-

powered T1 radio of the present invention may be installed is diagrammatically illustrated in Figure 1 as comprising a first or 'west' site 10, such as a central office, that provides digital (e.g., T1 rate 5 (1.544 Mb/s)) telecommunication service by way of a powered wireline link or span 20 to various digital communication (DS0-based) equipments that are coupled to the wireline. In a typical network, the wireline 20 may include one or more repeaters 30 installed at 10 regular intervals along the link, to provide for substantial land line extended digital service to relatively remote customers served by the network.

A remote (relatively 'eastward' as viewed in Figure 1) end 22 of the 'west' link 20 is shown as 15 terminating at a wireless transceiver site 40, where it is desired to place a digital communications radio (e.g., 2.4 GHz 'blue tooth' radio) 50, for conducting wireless communications with one or more digital ('blue tooth') radios serving one or more remote customer 20 digital equipments. As a non-limiting example, in the case of a building environment, transceiver site 40 may comprise rooftop or pole-mounted housing fixture that may be coupled to a section of wireline, such as that sourced from a (ceiling-installed) repeater 'can'. As 25 such, transceiver site 40 does not have ready access to a dedicated power supply with which to power a radio at

the site.

In a like manner, a remote radio with which the transceiver site 40 is to communicate may correspond to a digital (e.g., blue tooth) radio 60 associated with 5 portable digital terminal equipment 70 (such as a notebook computer), or a remote digital radio 80 that terminates a separate 'east' wireline 90. In the latter instance, the 'east' wireline 90 may be similar to wireline 20 of the 'west' side of the system, in that 10 it is a powered span and may contain one or more repeaters 100 installed at regular intervals, and having a termination end 92 at a remote (central office) site 110.

Figure 2 diagrammatically illustrates the loop-powered digital radio of the present invention, which 15 is configured so that it may be readily installed at a transceiver site where access to the wireline is afforded, but no power supply is available or readily installable, such as the site 40 at the terminal end 22 of the 'west' link 20 or site 80 of the 'east' link 90. As shown in Figure 2, the loop-powered radio of the invention includes a line interface circuit 210, that 20 is adapted to be coupled to tip (T) and ring (R) portions of respective transmit and receive portions 25 201 and 202 of a powered T1 wireline link, such as line 20 in the system of Figure 1. The line interface 210

contains conventional coupling transformer circuitry that extracts the (+/-48 VDC) voltages of the powered tip and ring wireline pairs for application to a power supply 220, on the one hand, and also interfaces 5 digital signals transported by the powered digital wireline to a standard T1 framer chip 230.

The power supply 220 preferably comprises a DC-DC voltage converter circuit of conventional design, which scales down the (+/-48 VDC) voltages supplied by the 10 span to standard voltages (e.g., +5 V and +12 V), that are coupled to the supply rails for the digital signaling and transceiver electronics of the digital radio. In the case of a conventional 'blue tooth' architecture, whose radiated power density 15 specification is relatively constrained, the +/-48 VDC provided by the powered wireline span is more than sufficient to allow the use of a DC-DC converter to power the radio.

The transceiver section 240 of the digital radio 20 is preferably of standard (e.g. 'blue tooth'-compatible) design and includes a transmitter unit 250 and a receiver unit 260. As in a standard (e.g., blue tooth) digital radio, the transmitter unit 250 is coupled to receive the digital baseband signals from 25 the T1 framer chip 230 and perform modulation and up-conversion to an FCC-conformal band RF signal (e.g.,

2.4 GHz spread spectrum signal) assigned for unlicensed wireless digital communications. Similarly, in the receive direction, the radio's receiver unit 260 down-converts and demodulates the (2.4 GHz spread spectrum) 5 RF signal coupled through a diplexer 270 to baseband for application to the T1 framer chip 230.

Since the loop-powered radio of the invention is configured to extract electrical power from the span and convert the extracted power to voltages necessary 10 to operate its transceiver and signal processing components, the invention is a totally self-contained architecture that effectively eliminates the need of having to locate the radio where a separate dedicated power supply is either available or can be installed. 15 Thus, the invention may be installed practically anywhere access to the powered (T1) wireline is available.

While we have shown and described an embodiment in accordance with the present invention, it is to be understood that the same is not limited thereto but is 20 susceptible to numerous changes and modifications as known to a person skilled in the art. We therefore do not wish to be limited to the details shown and described herein, but intend to cover all such changes and modifications as are obvious to one of ordinary 25 skill in the art.